

**PATENT APPLICATION OF**

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**ENTITLED**

**SENSOR AND INTERLOCK OF AN INDUSTRIAL  
VEHICLE**

## **SENSOR AND INTERLOCK ON AN INDUSTRIAL VEHICLE**

### BACKGROUND OF THE INVENTION

The present invention relates to an  
5 interlock system for determining whether a door or  
cover is closed and latched. When a door on a cab on  
an industrial vehicle, such as a skid steer loader,  
is unlatched, a lock out signal to disable components  
of the vehicle is provided until such time as the cab  
10 door is again closed and latched.

Skid steer loaders are operated with  
rollover protection cabs, and in inclement weather,  
either hot or cold, the cab can be enclosed, and a  
door provided on the operator entrance opening. It  
15 has been found that because of the compact nature of  
skid steer loader, in particular, if the door is  
fully opened and the lift arms of the loader are  
operated, the door can become damaged by the lift  
arms.

### SUMMARY OF THE INVENTION

The present invention relates to a sensor  
for determining when a latch on a door or other  
hinged cover is closed and latched to provide a  
signal indicating the door or cover is properly  
25 latched closed. The signal is used, as disclosed, as  
a signal to an interlock system, and when the latch  
is not properly secured with the door closed, that  
is, when the door is ajar or open, controls for  
operation of some secondary system, such as the lift

arm and bucket tilt cylinder of a loader, are disabled.

A switch used for determining when the door is closed and latched can be a magnetic reed switch  
5 or a Hall effect sensor, with a magnet mounted on a latch striker or bolt secured to the frame of the cab. The sensor is positioned on the door so that unless the door latch is adjacent to and in alignment with the magnet on the striker bolt, that is, fully  
10 seated or secured, there will be no enabling signal to permit operation of the selected system, for example, the lift and tilt cylinders of the loader, that are used for operation of the lift arms.

The skid steer loaders that are made by  
15 Bobcat Company, a business unit of Ingersoll-Rand Company presently include a interlock control system that prevents operation of the vehicle in response to selected sensor inputs indicating a selected condition. The sensor of the present invention is  
20 designed to provide an input to such a system so that when the door is in place on the cab, an additional signal from the latch sensor is needed to enable the operation of the lift arms and bucket cylinders of the skid steer loader. The same arrangement can be  
25 used for locking our functions on other vehicles or systems that have a door or cover that should be closed and latched before the selected functions are enabled.

The present door shown will provide an input to similar interlock systems where a controller is disabled when the sensor signal indicates that a door or cover is not closed and latched.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic perspective view of a skid steer loader having an interlock system made according to the present invention;

10 Figure 2 is a fragmentary perspective view of a typical door and latch arrangement;

Figure 3 is an enlarged, exploded rear perspective view of a door frame and latch assembly as viewed from the interior of the cab;

15 Figure 4 is an enlarged exploded perspective view showing a typical latch assembly from an exterior of a cab door having a sensor system of the present invention installed;

20 Figure 5 is a rear view of the latch from the interior of the cab showing the striker and the door latch in a latched position with parts broken away;

Figure 6 is a schematic rear view of a latch having a modified sensor, showing the latch and a sensor from an interior of the cab;

25 Figure 7 is a side sectional view of Figure 6; and

Figure 8 is a fragmentary detailed view of a latch striker of Figure 6, with parts broken away.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A skid steer loader 10 is shown in Figure 1, and it has a frame 12, supported on wheels 14, and further it has a pair of pivoting lift arms 16 that are operated with hydraulic actuators 18. The lift arms support a tilting bucket 15 that is raised with the lift arms and tilted using a tilt hydraulic cylinder or actuator 17. The skid steer loader has a cab 20, as shown, and in this instance, a door assembly 22 (see Figure 2) is provided on the cab. The door can hinge between an open and closed position. An engine 24 is used for providing power to a hydraulic system including a hydraulic pump 26 connected to a lockout valve 36, and providing power to a set of actuator hydraulic valves 28 and then to the various hydraulic components such as the lift arm actuator 18 and bucket tilt actuator 17. Drive hydraulic motors 30 are used for driving the wheels 14 in a conventional manner.

A drive interlock system 32, is provided as is disclosed in United States Patent No. 5,425,431 in greater detail. The specification of Patent No. 5,425,431 is incorporated by reference. The interlock system 32 has logic controls that, among other functions, enables or disables the operation of actuator hydraulic valves 28, through a lockout valve 36 and it also can control operation of drive motors 30 (or other drive), through a drive lockout 31. Operation of the lift arm cylinders or actuators 18,

and the tilt cylinders or actuators 17 is enabled only when lockout valve 36 is open.

In the present invention, whenever a door is installed on a cab, a circuit is closed by a  
5 normally closed switch or sensor 56 on the door latch, that will be more fully explained, unless the door is closed and a door latch is secured or latched. The closing and latching of the door assembly 22 relative to the cab frame around the door  
10 opening on the cab 20 provides a signal to the interlock system 32 by opening the switch or sensor 56 so the lockout valve 36 is enabled or open and the actuator valves 28 receive hydraulic fluid under pressure. The valves 28 can then be operated to  
15 provide hydraulic fluid to the cylinders 18, and 17.

If desired, the door latch switch or sensor can be used to control other functions of a vehicle, such as operating the drive lockout 31 to prevent the vehicle or loader from moving until the door is  
20 closed and latched. Interlock valve 36 must be open in order for hydraulic fluid under pressure to be provided to the hydraulic valves 28. When interlock valve is closed or disabled it completely shuts off the operation of the selected components or functions  
25 of the machine including hydraulic cylinders. The lift actuators 18 and tilt actuator 17 are disabled until the door is closed and latched. Other inputs 33, as disclosed in U.S. Patent No. 5,425,431, also

may be needed to enable valve 36 and drive lockout 31.

The door 32 is hinged as at 40, along one side relative to the cab, and is positioned in a door opening frame shown at 42. The door assembly 22 is generally made with an exterior peripheral frame in which a transparent panel is supported as shown in United States Design Patent No. D437,275. The door has a handle panel portion 44 that includes a latch assembly plate 46.

The latch assembly plate 46 supports a conventional door latch assembly 48, that is operated from a push button handle 50, also of conventional design. The push button on the handle engages a lever 50A on the interior of the door that operates cams to open the door. An operator handle 53 in the cab 20 permits the operator to open the door. The handle 50 is securely clamped onto the latch plate 46.

Movement of the push button on handle 50 operates against lever 50A so cams move in a conventional manner and open or separate a pair of spring loaded latch dogs 52, that are pivotally mounted between a plate 49 as supported in a latch housing 58, and an outer wall 59 of the latch housing 58. The details of the latch operator are not shown, but the push buttons and lever operate to open or separate the latch dogs 52, which are spring loaded to a closed position.

The latch housing 58 is used to also support a normally closed latch sensor or switch 56 that is mounted on a bracket 57 which is attached to an inner side of plate 49. The closed switch 56  
5 closes a circuit and provides a signal to the interlock system controller 32 to close lockout valve 36 whenever a door is installed. The latch housing wall 59 and plate 49 have U-shaped openings or notches 60 that are open on the interior side of the  
10 latch and that will receive a latch striker bar 62 that is mounted onto the door opening frame wall 65 on the cab. An end 63 of the latch striker bar 62, extends through an opening in wall 65, forming part of the door opening frame on the cab and is held  
15 fixed on the wall 65 with a nut in a normal manner.

The latch striker bar 62 is a cylindrical shaft. The latch dogs 52 will cam on the latch striker bar and the spring load on the latch dogs permits them to separate to fit over the striker bar  
20 62 and latch in place when the door is fully closed.

The latch striker carries a permanent, preferably high strength, magnet 66 on a head end 67 of the striker bar. The magnet 66 is suitably positioned to be aligned with an adjacent sensor or  
25 switch 56 only when the door is in closed and latched position. The notches 60 in wall 49 are open so the magnetic field from magnet 66 affects notch or sensor 56 when the door is closed and latched. The magnet 66 is held in a recess in the head end 67 of the



striker bar 62, which can be seen in Figure 5 where the head end 67 of the striker bar 62 has been broken away. When the door is closed and latched, the normally closed sensor or switch 56 will be shifted  
5 in state or position to open due to the presence of the magnetic field from the magnet 66.

The sensor 56 can be a magnetic reed switch, or can be a Hall effect sensor with the actuating magnet 66 carried in the striker bolt or  
10 bar 62.

The sensor leads are extended along the door frame 40 that is used for supporting the glass in the door, and the leads are connected with a coupler 70 on the door that connects to a connector  
15 71 on the frame 12 of the loader that leads to the controller 32.

In many instances, an industrial vehicle will be operated without a door, and thus, the present arrangement is designed to permit operation  
20 of the loader lift and tilt cylinders when a door is not used. The wiring on the loader body can remain in place and the lift and tilt cylinders will be operable.

When a door is not originally present or is  
25 taken off, the coupler 70 is separated from connector 71 and the circuit to the interlock controller is open. The normally closed switch or sensor 56 is removed with the door. With the circuit open, there

is no signal from the door circuit that causes the controller 32 to close the interlock valve 36.

The switch or sensor 56 is normally closed as stated, and when the door is installed, the  
5 coupler 70 is connected to connector 71 on the frame 12. The switch 56 is closed and the controller 32 causes the valve 36 to move to position to block operation of the loader lift and tilt actuators. When the door is removed and the coupler 70 and connector  
10 71 separate, the sensor or switch 56 is no longer in the circuit so the circuit is open and the interlock valve 36 is not closed by the door latch circuit.

When the door 23 is in place, the door 22 preferably has to be closed and latched so that the  
15 sensor component 56 on the door is operated (opened) by the component on the striker or on a fixed portion on the cab, such as a door frame to "enable" the interlock valve 36.

It also should be noted that the latch can  
20 be on the cab, and a fixed striker positioned on the door. When desired, the sensor arrangement can be selected to sense a door closed, but not fully latched position. The door position could be one where it was known that the door was not going to  
25 interfere with, or be in the way of, the lift arm movement.

Figures 9 and 10 show a modified form of the invention schematically. A latch plate 76 that mounts onto a door 78 is shown in latched position,

with latch dogs 80. A striker cylinder or bar 82 is held in the latch dogs. The striker bar is mounted onto a fixed cab frame wall 84.

In this form of the invention, the striker  
5 bar 82 has a flange 88 that carries locating pins 90 that are not symmetrical about the axis of the striker bar, and which will fit in provided receptacles 92 in the cab frame wall to make sure that the positioning of the magnet 94 is correct for  
10 alignment with a Hall effect sensor 96 that is supported on the latch housing 98.

The magnet 94, as shown in Figure 9, is inserted into a cross hole or bore 100 in the striker bar. Hole 100 is of size to receive the magnet 94. A  
15 smaller diameter cross bore 102 is provided in alignment with the bore 100, so that the magnet can be either pushed out or pounded out of hole 100 for replacement.

The Hall effect sensor 96 is connected to  
20 the interlock system 32 so that when the door is on the loader but is not closed sufficiently the lift and tilt actuators and other selected power components are disabled, as previously explained. Variations in sensors thus can be made, and  
25 variations in magnet mounting also can be provided.

The strength of the magnet field, and the sensitivity of the sensor can be selected so that mounting one or both of the sensor components adjacent the latch and/or striker will provide a door

position signal that will enable the lift arms when the door will not be in the path of the lift arms.

In automotive applications, a door striker for a door latch is used and the same sensor system  
5 can be utilized. Some door latches operate so that if tripped but not fully latched, the door latches have to be reset by operating the door latch before the door can be fully closed and latched. The sensor system of the present invention is preferably  
10 sensitive to the fully closed and latched position of the door and will not permit operation of the controlled function until both door closing and latching occurs. However, as pointed out, in some applications a signal indicating the door is in a  
15 closed or newly closed position is satisfactory.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without  
20 departing from the spirit and scope of the invention.